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TAMPER-INDICATING CLOSURE, CONTAINER, PACKAGE AND METHODS OF MANUFACTURE

This application is a division of application Serial No. 09/996,190 filed November 18, 2001.

The present invention is directed to beverage packages, and more particularly to closures and containers for such packages, and to methods of manufacturing such closures and containers. Preferred aspects of the invention relate to improved drainage of product from between the container finish and the closure skirt after filling and capping the container.

Background and Objects of the Invention

It is conventional to form a tamper-indicating closure having a band connected to a skirt by integral frangible means, such as frangible bridges or a frangible web. The band has a stop element (e.g., a flange or a bead) that engages a bead on the container finish to resist unthreading of the closure, so that removal of the closure ruptures the frangible means that connect the band to the skirt. U.S. Patents Re33,265, 4,322,009 and 4,432,461, assigned to an assignee of the present application, disclose tamper-indicating closures of this character, in which the tamper-indicating band is completely severed from the closure skirt and remains on the container upon removal of the closure from the container. U.S. Patents 5,295,600 and 6,224,802, also assigned to an assignee of the present application, disclose tamper-indicating closures in which the tamper-indicating band remains connected to the closure skirt and is removed from the container with the closure.

Although tamper-indicating closures and packages of the types disclosed in the noted patents have enjoyed substantial commercial acceptance and success, further improvements

remain desirable. For example, problems are encountered when employing this type of closure in so-called wet finish applications, in which liquid may spill during or after the filling operation onto the outside surface of the container so as to be disposed between the container finish and the closure skirt after capping. Wet finish situations of this type are encountered during, for example, hot-fill, cold-fill and aseptic-fill situations, in which the containers are filled close to the brim or to overflow prior to capping. Wet finish situations can also be encountered during filling operations in which liquid may drip from the filling machinery onto the container finish. In wet finish situations of this type, problems are encountered in connection with draining and drying of the area between the outside surface of the container finish and the inside of the closure skirt - i.e., between the threads on the container finish and skirt, and around the tamper-indicating band and the stop element. Liquid trapped within this area can result in growth of mold or mildew, and when dry undesirably increases the torque required for removal of the closure from the container.

U.S. Patents 6,119,883 and 6,152,316, assigned to an assignee of the present application, disclose tamper-indicating closures in which drain openings are provided at the juncture of the tamper-indicating band and the stop flange - i.e., through the stop flange adjacent to the band, through the band adjacent to the stop flange, or through the hinge portion in both the stop flange and the tamper-indicating band. A plurality of these drain openings, disposed in a circumferentially spaced array around the closure, improve product drainage in the area of the tamper-indicating band and the stop flange. U.S. Patent 6,253,940, assigned to an assignee of the present application, illustrates a closure having drain openings at the juncture of the stop flange and the band, and openings in a flared portion of the closure skirt for admitting flushing solution. This helps flush liquid from between the container finish and the closure in the area of the stop flange and the tamper-indicating band.

It is a general object of the present invention to provide a closure and/or a container and/or a closure and container package that is/are specifically constructed to improve liquid product drainage from between the container finish and the closure in wet finish and other similar situations. Another and related object of the invention is to provide a method of manufacturing such a closure and/or container.

Summary of the Invention

The present invention involves a number of aspects that may be implemented from, or more preferably in combination with each other.

In accordance with a first aspect of the present invention, a tamper-indicating closure of integrally molded plastic construction includes a base wall having a peripheral skirt with at least one internal thread for securing the closure a container, a tamper-indicating band frangibly connected to an edge of the skirt, a stop element extending axially and radially from the band remote from the skirt, a plurality of circumferentially spaced drain openings extending through the band and/or the stop element, and a plurality of circumferentially spaced channels or grooves extending axially through the internal thread within the closure skirt. At least some of these channels or grooves are axially aligned with drain openings at the hinge portion of the stop flange to promote drainage of liquid through the channels and through the drain openings. The drain openings are preferably uniformly circumferentially spaced around the closure, while the channels or grooves through the internal thread are preferably non-uniformly spaced and clustered at the lead-in of the thread. The preferred embodiments of the invention include double threads having diametrically opposed lead-ins, with the axial channels or grooves being clustered at lesser spacing from each other adjacent to the thread lead-ins.

A beverage container in accordance with another aspect of the invention includes a cylindrical finish having an open mouth, at least one external thread for securing a closure to

the finish, an external circumferential stop bead on a side of the thread remote from the container mouth, and an external support flange on a side of the bead remote from the mouth. The stop bead includes a plurality of circumferentially spaced bead segments that are separated from each other by circumferential gaps. A plurality of circumferentially spaced drain elements on the support flange are each axially aligned with a corresponding gap in the stop bead. Fluid may thus freely drain along the external surface of the container finish through the gaps in the stop bead and the drain elements on the support flange. The drain elements on the support flange in one preferred embodiment in accordance with this aspect of the invention take the form of drain grooves on a surface of the support flange axially facing the stop bead. Each groove has a bottom surface that is angulated radially outwardly and axially downwardly away from the bead. The drain elements in accordance with another embodiment of this aspect of the invention comprise drain slots that extend axially through the support flange. The finish preferably has an outer circumferential wall surface, with the external thread, the external bead and the external support flange extending radially outwardly from this wall surface. The gaps in the stop bead and the slots through the support flange are formed by corresponding portions of the wall surface. Thus, fluid may readily flow through these gaps and slots. In the preferred embodiments of the invention, the container is of integrally molded plastic construction, although this aspect of the invention may also readily be implemented in containers of glass construction, for example.

A container and closure package in accordance with another aspect of the invention includes a container having a finish with at least one external thread and an external bead disposed beneath the thread. The closure includes a base wall having a peripheral skirt with at least one internal thread for securing the closure to the external thread on the container finish, a tamper-indicating band frangibly connected to an edge of the skirt, and a stop element extending from the band for abutment with the bead on the container finish. Drain openings are

provided in the stop element and/or the band. A plurality of circumferentially spaced axial channels or grooves extend along the inside of the skirt through the internal thread, at least some of which are in axial alignment with drain openings.

A closure and container package in accordance with a further aspect of the invention includes a container having a finish with at least one external thread, an external circumferential bead defined by a plurality of circumferentially spaced bead segments separated from each other by circumferential gaps, an external flange on a side of the bead remote from the thread, and a plurality of circumferentially spaced drain elements on the flange and each axially aligned with a corresponding gap in the bead. The closure includes a base wall having a peripheral skirt and at least one internal thread for affixing the closure to the external thread on the container finish. A tamper-indicating band is frangibly connected to the skirt, and a stop element extends from the band for abutment with the bead on the container finish. Drain openings may be provided, but need not necessarily be provided in accordance with this aspect of the invention, in the stop element and/or the tamper-indicating band.

In accordance with yet another aspect of the present invention, a method of making a tamper-indicating closure contemplates integrally molding the closure of plastic as-molded construction that includes a base wall having a peripheral skirt with at least one internal thread for affixing the closure to a container, a tamper-indicating band frangibly connected to an edge of the skirt, a stop element extending from the band, and a plurality of circumferentially spaced drain openings extending through the band adjacent to the stop element, through the stop element adjacent to the band, or through both the element and the band. The step of molding the closure is such that a plurality of circumferentially spaced channels or grooves are formed extending axially through the internal thread, with at least some of the grooves being axially aligned with drain openings in the stop element and/or band.

A method of making a beverage container in accordance with a further aspect of the present invention includes integrally molding a container having a cylindrical finish with an open mouth, at least one external thread, an external circumferential bead on a side of the thread remote from the mouth and an external circumferential flange on a side of the bead remote from the thread. The step of molding the container is such that the bead comprises a plurality of circumferentially spaced bead segments separated from each other by circumferential gaps, and the flange includes a plurality of circumferentially spaced drain elements each axially aligned with a corresponding gap in the bead. These drain elements preferably include drain grooves or slots in the external flange. The bead segments are preferably of uniform circumferential dimension and at uniform circumferential spacing. The container is preferably of molded plastic construction, although this aspect of the invention may also be implemented in glass containers, for example.

Brief Description of the Drawings

The invention, together with additional objects, features and advantages thereof, will be best understood from the following description, the appended claims and the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view of a closure and container package in accordance with one presently preferred embodiment of the invention;

FIG. 2 is a fragmentary sectional that illustrates the container finish and closure in the package of FIG. 1;

FIG. 3 is a partially sectioned side elevational view of the closure in the package of FIGS. 1 and 2 as molded - i.e., before stop flange inversion;

FIG. 4 is a bottom plan view of the closure illustrated in FIG. 3;

FIG. 5 is a fragmentary sectional view taken substantially along the line 5-5 in FIG. 4;

FIG. 6 is a developed elevational view of the inside circumference of the closure illustrated in FIGS. 3-5;

FIG. 7 is a partially sectioned elevational view similar to that of FIG. 3 but showing a closure in accordance with a modified embodiment of the invention;

FIG. 8 is a bottom plan view of the closure illustrated in FIG. 7;

FIG. 9 is a developed elevational view of the inside circumference of the closure in FIGS. 7 and 8;

FIG. 10 is a fragmentary perspective view of the container finish in the package of FIGS. 1 and 2;

FIG. 11 is a fragmentary side elevational view of a container having a finish in accordance with another aspect of the present invention;

FIGS. 12, 13 and 14 are fragmentary sectional views taken substantially along the respective lines 12-12, 13-13 and 14-14 in FIG. 11;

FIG. 15 is a developed elevational view of the outside surface of the container finish in FIG. 11; and

FIG. 16 is a fragmentary elevational view that illustrates a modification to the embodiment of FIG. 11.

Detailed Description of Preferred Embodiments

FIGS. 1 and 2 illustrate a closure and container package 20 in accordance with one presently preferred embodiment of the invention as comprising a closure 22 secured to the finish 24 of a container 26. Closure 22 includes a base wall 28 from which a peripheral skirt 30 extends. At least one internal thread 32 extends around the inside surface of closure skirt 30.

A tamper-indicating band 34 is connected by frangible means 36 to the free edge of skirt 30 remote from base wall 28. Frangible means 36 may comprise frangible bridges or a frangible membrane in the closure as molded and/or scored into the closure after molding. A stop flange 38 extends axially and radially from the lower edge of tamper-indicating band 34, being connected thereto by a hinge portion 40. (Directional words such as "axially" and "radially" are employed for purposes of description and not limitation, and are taken with respect to the central axis of the closure when a closure is being discussed or the central axis of the container finish when the container finish is being discussed. Directional words such as "upward" and "downward" are taken with respect to the upright orientation of the package and components illustrated in the drawings.) Container 26 includes a body 42 for containing a beverage product and from which cylindrical finish 24 extends. Finish 24 has an open mouth 44, at least one external thread 46 engaged by internal thread 32 on closure skirt 30 to secure closure 22 to container 26, and a radially outwardly extending external stop bead 48 on the opposite side of thread 46 from mouth 44. Bead 48 has an axially facing shoulder 50 that is engaged by an opposing end of flange 38 when closure 22 is in position on container 26. Abutment of flange 38 against bead 48 causes rupture of frangible means 36 as closure 22 is unthreaded from container finish 28 so that band 34 indicates tampering with the closure. A liner 52 may be secured or otherwise disposed on the inner surface of closure base wall 28 for sealing engagement with the upper edge of finish 24 to seal the contents of the container. Alternatively, but less preferably, the closure may be a linerless closure with sealing means of conventional type.

Closure 22 is illustrated in greater detail in FIGS. 3-6. A plurality of channels or grooves 54 extend axially along the inside surface of closure skirt 30 through internal thread 32. More specifically, and as best seen in FIGS. 4 and 6, thread 32 comprises a double thread 32a,

32b each having an associated lead-in disposed adjacent to base wall 28. In the illustrated embodiment, there are eight circumferentially spaced channels 54a-54h extending through threads 32a, 32b, with the circumferential spacing between and among the channels being non-uniform around the inside surface of the closure skirt. Channels 54a, 54b, 54c are clustered adjacent to the lead-in of thread 32a, while channels 54e, 54f, 54g are clustered adjacent to the lead-in of thread 32b. Channels 54d and 54h are spaced from the thread lead-ins, and are at greater circumferential spacing from channel groups 54a-54c and 54e-54g than the channel spacing within the respective groups. In a 43 mm embodiment of closure 22, channel 54a is 15° from full start of thread 32a, channel 54b is 30° from channel 54a, and channel 54c is 30° from channel 54b. Channel 54d is at 50° spacing from channel 54c, and channel 54e is at 70° spacing from 54d. Channels 54e, 54f, 54g and 54b are diametrically opposite channels 54a, 54b, 54c, and 54d respectively. As best seen in FIG. 5, each channel 54 is slightly indented into the inside surface of closure sidewall 30. In the illustrated 43 mm embodiment of the invention, this indentation is in the range of 0.012 to 0.014 inches, and channels 54 each have a tangential dimension of 0.125 ± 0.007 inch.

A circumferential array of axial drain openings 56 are formed at the juncture of stop flange 38 and tamper-indicating band 34, either entirely within the stop flange, entirely within the band, or partially within both the flange and the band as illustrated in the drawings. As best seen in FIGS. 4 and 6, there are eight drain openings 56a-56h in the illustrated embodiment of the invention at uniform 45° spacing from each other. Channels 54b, 54d, 54f and 54h are axially aligned with corresponding drain openings 56b, 56d, 56f and 56h. The remaining channels and drain openings are not axially aligned in the illustrated embodiment of the invention. Channels 54a, 54b, 54c and channels 54e, 54f, 54g are clustered in the areas of dual-thread overlap because of the need for enhanced drainage in this area. In a single-thread

closure, channels 54a-54h can be uniformly spaced around the closure and all axially aligned with associated drain openings 56a-56h. Drain openings 56 in the illustrated embodiment of the invention have a radial dimension of 0.030 and a tangential dimension of 0.125 ± 0.007 inch. Closure 22 is preferably of integrally molded plastic construction such as polypropylene. Channels 54 and drain openings 56 are molded into the closure, and frangible means 36 is either molded into the closure or scored into the closure in an after-molding operation.

After filling of container 26 with a beverage, closure 22 is applied to the container finish in a conventional capping operation. Any liquid product disposed on the external surface of the container finish can drain through channels 54 that extend through the closure internal thread(s). In this connection, recessing of the channels into the closure skirt, as illustrated in FIG. 5, promotes drainage of the liquid past the external thread(s) on the container finish. The liquid may then drain downwardly between flange 38 and band 34, and thence through drain openings 56. In this connection, it will be appreciated that alignment of channels 54b, 54d, 54f and 54h with corresponding drain openings 56b, 56d, 56f and 56h helps promote this liquid drainage.

FIG. 10 illustrates container finish 24 in accordance with another aspect of the invention. Finish bead 48 is not circumferentially continuous in FIG. 10, but rather comprises a plurality of external bead segments 48a-48f. These bead segments are circumferentially spaced from each other by gaps, such as gaps 58b, 58c, 58d in FIG. 10. In this embodiment, finish 24 has a generally cylindrical outer surface from which dual external thread 46a, 46b and segmented external bead 48a-48f radially extend. Gaps 58b-58d are continuations of the outer finish wall surface between the bead segments. Thus, in this embodiment, fluid that flows from between the finish outer surface and the skirt inner surface, such as through channels 54 on the skirt inner surface and/or corresponding channels on the finish outer surface, can flow through the gaps or spaces 58b-58d between segments of bead 48. This finish configuration greatly facilitates fluid

drainage. Exemplary dimension for bead segments 48a, etc. and gaps 58b, etc., for an exemplary 48mm embodiment of the invention, are given in connection with FIGS. 11-15. A container embodying the segmented stop bead configuration of FIG. 10 is preferably of molded plastic construction such as PET. Alternatively, this aspect of the invention can be implemented in otherwise conventional glass containers.

FIGS. 7-9 illustrate a closure 60 in accordance with a modified embodiment of the invention. In FIGS. 7-9 (and 10-16), elements identical or similar to those in FIGS. 2-6 are indicated by correspondingly identical reference numerals. The primary difference between closure 60 in FIGS. 7-9 and closure 22 in FIGS. 2-6 is that no drain openings 56 are provided in stop flange 38 and/or band 34. Thus, closure 60 of FIGS. 7-9 is particularly well suited for use in conjunction with the container finish illustrated in FIG. 10, in which drain passages are provided between segments of the finish bead.

FIGS. 11-15 illustrate a container 70 in accordance with one embodiment of another aspect of the invention. Container 70 includes a body for holding a beverage, and a cylindrical container finish 74. Finish 74 includes a pair of external threads 46a, 46b for securing a closure to the container finish, an external stop bead 48, also known as an A bead, and an external support flange 82 also known as a support ledge or capping flange. Container finish 74, including support flange 82, is typical of injection blow molded containers. Stop bead 48 comprises a plurality of circumferentially spaced bead segments 48a through 48j, which are spaced from each other by inter-segment gaps 58a - 58j. Bead 48, defined by bead segments 48a - 48j and intervening slots or gaps 58a - 58j, is disposed in a plane perpendicular to the finish axis on a side of threads 48a, 48b remote from the container mouth, and function in cooperation with a stop bead or a stop flange on a closure to provide the tamper-indicating function previously described. Support flange 82 is circumferentially continuous in the embodiment of FIGS. 11-13

in a plane parallel to bead 48, and has an upper surface facing in the direction of bead 48. The upper surface of flange 82 has a plurality of circumferentially spaced drain channels or grooves 82a through 82j. The number of drain grooves 82a - 82j is preferably identical to the number of slots 58a - 58j in bead 48, and each flange groove 82a - 82j is axially aligned with a corresponding bead slot 58a - 58j. Each groove 82a - 82j has a bottom surface at an axially downward and radially outward angle with respect to the container finish axis to promote drainage of liquid from the grooves. Thus, any liquid on the external surface of finish 74 can readily drain through bead slots 58a - 58j and correspondingly aligned flange grooves 82a - 82j.

The container 70 illustrated in FIGS. 11-15 (and the container in FIG. 10) is blow molded in a two-piece mold that forms a parting line PL. Bead segments 48a - 48j and bead spaces 58a - 58j, and slots 82a - 82j in FIG. 14, are oriented at angles to parting line PL to facilitate mold separation, as best seen in FIGS. 13-14. As a design starting point, segments 48a - 48j have equal tangential dimension, spaces 58a - 58j have equal tangential dimension and slots 82a - 82j have tangential dimensions corresponding to spaces 58a - 58j. These dimensions are then varied to facilitate mold parting. By way of example for a 43mm embodiment, segments 48e and 48j at parting line PL may have a tangential dimension of 0.378 inch, and spaces 58b, 58g at right angles to parting line PL may have tangential dimensions of 0.202 inch. All of the spaces 58a - 58j extend radially from the cylindrical outer surface of the finish to the outer edges of the bead segments. Angularly of the finish axis, spaces 58a - 58j have dimensions of 14.2° (spaces 58a, 58c, 58f and 58h), 15° (spaces 58b and 58g) and 17.13° (spaces 58d, 58e, 58i and 58j). Segments 48a - 48j have dimensions of 28° (segments 48e and 48j), 17.5° (segments 48a, 48d, 48f and 48i), and 19.52° (segments 48b, 48c, 48g and 48h). The angular dimension of each channel or groove 82a - 82j may be slightly larger than the angular dimension of the slots. The bottom surface of each groove 82a - 82j has a downward angle of 5° in the illustrated

embodiment. In the illustrated embodiment, grooves 82a - 82j have angular dimensions of 11°20' (grooves 82b and 82g), 12°21' (grooves 82a, 82c, 82f and 82h), and 18° 20' (grooves 82d, 82e, 82i and 82j).

FIG. 16 illustrates a modification 90 to the embodiment of FIGS. 11-13, in which the container finish 92 has external threads 46a, 46b and segmented bead 48 as previously described. The support flange 94 in the embodiment of FIG. 11 has circumferentially spaced spaces or gaps 94a, 94b, etc., each of which is axially aligned with a corresponding space or gap 58a, 58b, etc. in stop bead 48. As in the embodiment of FIG. 10, each gap 58a, 58b, etc. in FIGS. 11-16, and each gap 94a, 94b, etc. in FIG. 16 comprises a continuation of the cylindrical outer wall surface of the container finish.

There have thus been disclosed a closure, a container, a closure and container package, and methods of making the closure and container that fully satisfy all of the objects and aims previously set forth. A number of modifications and variations have been discussed in connection with the presently preferred embodiments of the invention. Other modifications and variations will readily suggest themselves to persons of ordinary skill in the art in view of the foregoing discussion. For example, the preferred embodiments of the closure include a stop element in the form of a flange 38. However, the stop element may comprise a radial bead, as shown in U.S. Patent 4,322,009, in accordance with the broadest aspects of the invention. The invention is by no means limited to the described 43mm embodiments of the invention, or to the exemplary dimensions disclosed in connection therewith. The invention is intended to embrace all such modifications and variations as fall within the spirit and broad scope of the appended claims.